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Vegetative Rehabilitation & Equipment Workshop

43rd Annual Report
Billings, Montana
February 19 & 20, 1989

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43rd Annual Report
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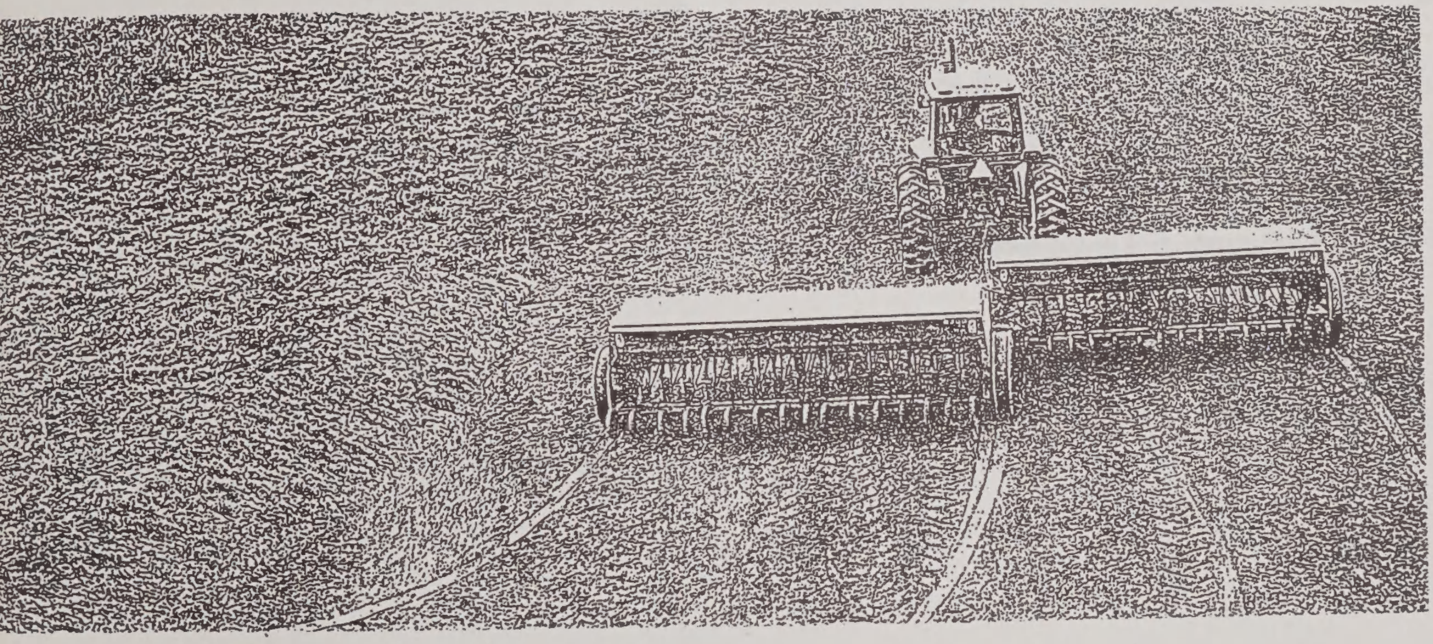

Participants

U.S. Department of Agriculture
U.S. Department of the Interior
State and County Organizations
State Wildlife Agencies
Industry, Representatives
(Chemical, Equipment, Mining, Seed)
Education Institutions
Ranchers
Foreign Countries

January 1990

Published by:

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Contents

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Chairman's Letter

May 19, 1989

Dear VREW Participants:

Approximately 170 people participated in the 1989 workshop in Billings. VREW continues to value the contribution of the "Commercial Exhibitors" in areas of technology transfer and product development. Concern has been expressed for additional emphasis on technology transfer and product development, opposed to general information discussions about company operations. As we strive to make the best possible meeting, we each must strive to discuss topics of technological interest to the attending audience.

My special thanks to those who continue to make VREW a success and have worked very diligently preparing for the June 3-4 meeting in Denver.

The books—"Fences" and "Facilities for Handling, Sheltering, and Trailing Livestock" have been published. The final book on "Facilities for Watering Livestock and Wildlife" will be available soon. Our special thanks to the crew at the Missoula Technology and Development Center for the publishing of these documents.

The 44th annual VREW meeting will be in Reno. Hope to see each of you there.

Sincerely,

Gerald A. Henke

GERALD A. HENKE
Chairman, Vegetative Rehabilitation
and Equipment Workshop

Agenda

Sunday, February 19. 1989

Opening Remarks.................................Gerald Henke, Chairman
Vegetative Rehabiltation and
Equipment Workshop

Range Research in Montana..................Dr. Clayton Marlow
Animal and Range Sciences
Montana State University
Bozeman, Montana 59717

Seed Drill Implements...........................Jim Truax
3609 Vera Cruz Avenue
Minneapolis, Minnesota

Blow Gun Ignition Device......................Phil Range
Bureau of Land Management
Boise Interagency Fire Center
10196 W. Edna
Boise, Idaho 83704

Rangeland Drill.....................................John Laird
Laird Welding and Mfg. Works
P.O. Box 1053
Merced, California 95341

Garrison Seed and Grain Co.................Key Crawford
P.O. Drawer 242D
Hereford, Texas 79045

Plant Materials for Mine Revegetation....Steve Monson
USDA Forest Service
Shrub Sciences Laboratory
735 N 500 E
Provo, Utah 84601

Plant Materials for Mine Revegatation....Larry Kleinman
Kiewit Mining Corporation
905 Leopard
Sheridan, Wyoming 82801

Meckler Plant Material Work.................Gary Noller
Upper Colorado Environmental
Plant Center
Box 448
Meeker, Colorado 81641

Current Picture of Range Seeding...........Steve Monson
USDA Forest Service
Shrub Sciences Laboratory
735 N 500 E
Provo, Utah 84601

Seed Producer Sources..........................Larry Lilley, Mgr. Grass Seed Div.
Daehnfeldt, Inc.
P.O. Box 947
Albany, Oregon 97321

Prescribed Burning................................Lou Gildemeister
Monsanto Co.
Wildfire Division
20-143rd St. SE
Lynnwood, Washington 98037

Casterline Seed....................................Larry Thompson
Casterline Seed, Inc.
P.O. Box 1377
Dodge City, Kansas 67801

Dow Chemicals....................................Bill Snyder
Dow Chemical Co.
4568 Highway 12 E
White Sulphur Springs,
Montana 59645

Sharp Brothers Seed.............................Art Armbrust
Sharp Bros Seed Co.
P.O. Box 140
Healy, Kansas 67850

Ag-Renewal..Weldon Miller
Ag-Renewal, Inc.
1710 Airport Rd
Weatherford, Oklahoma 7309

Anderson Seed Co................................Don Hijar
Anderson Seed Co
P.O. Box 2252
Greeley, Colorado 80632

Arid Land Seeding Disc Chain..............Harold Wiedemann
Texas Agricultural Exp. Sta.
P.O. Box 1658
Vernon, Texas 76384

Disc Chain - Greenstrip..........................Mike Pellant
USDI BLM
Idaho State Office
3380 Americana Terrace
Boise, Idaho 83706

Disc Chain - Sagebrush..........................Steve Monsen
USDA Forest Service
Shrub Sciences Laboratory
735 N 500 E
Provo, Utah 84601

Tire Drag..Dave Meyers
USDA Forest Service
Heker Ranger District
Uinta National Forest
P.O. Box 190
Heber, Utah 84032

Monday, February 20, 1989

Plant Materials.......................................	Wendall Oaks USDA Soil Conservation Service Plant Material Center 1036 Miller St SW Los Lunas,New Mexico 87031
Plant Materials - Wisconsin....................	Russ Haas USDA Soil Conservation Service Plant Materials Center P.O. Box 1458 Bismark, North Dakota 58502
Plant Materials - Northwest....................	Scott Lambert USDA Soil Convervation Service Plant Materials Rt l, Box 1189 Bridger, Montana 590l4
VREW - An Agency Viewpoint Panel.....	Steve Monsen Bob Williamson Billy Templeton Paul Macauly Harold Weidamann USDA Forest Service Shrub Sciences Laboratory 735 N 500 E Provo, Utah 84601
Information and Publications.................	Dick Hallman USDA Forest Service MTDC Bldg. 1, Fort Missoula Missoula, Montana 59801
VREW Business Meeting........................	Gerald Henke, Chairman VREW

What Is VREW?

Dan W. McKenzie, Forest Service, San Dimas, California. Excerpts from text in History of the Vegetative and Equipment Workshop (VREW) 1946-1981, USDA Forest Service Missoula Technology and Devlopment Special Report 8222 2805, 1982.

The Vegetative Rehabilitation and Equipment Workshop (VREW) is an informal organization interested in developing and testing revegetation equipment and providing information about suitable equipment to land managers. Formerly known as the Reseeding Equipment Development Committee and then as the Range Seeding Equipment Committee, VREW is mainly concerned with equipment for rangeland improvement and disturbed land reclamation.

VREW is an ad hoc group without by-laws, membershp requirements, or dues. Meetings are held each winter, usually in conjunction with, and just prior to, the annual meetings of the Society for Range Management. Most of the workshops have been held in the Western United States. Workshop participants revieew accomplishments, discuss development activities, and present new information concerning revegetation equipment or techniques.

VREW includes representatives from Federal and State agencies, universities, industries, and other organizations. Representatives from foreign countries such as Canada, Mexico, Kuwait, Niger, Morrocco, Kenya, Argentina, and Australia also participate. Major funding agencies have been the Forest Service, the Agricultural Reserach Service, the Extension Service-Natural Resources, and the Soil Conservation Service. State agencies such as Fish and Game departments, Highway departments, and Extension Services have contributed personnel and facilities for field tests and evaluation. In recent years, industries, including equipment manufacturers, seed suppliers, mining companies, ranchers, and consulting firms have become increasingly involved in VREW.

The chairman of VREW has traditionally been the Assistant Director of the Forest Service Range Management Saff in charge of Cooperative Programs. This allows administration and coordination of Range and Resource programs with the Technology and Development Centers at San Dimas, California, and Missoula, Montana. The VREW Chairman handles many of the administrative details of the workshop, acts as a liaison among agencies, and heads both the Steering and Exploratory Committees of the workshop.

The Steering Committee is comprised of representatives from each major funding agency. They examine the projects and set priorities according to field needs, then assign the approved projects to workgroups.

The Exploratory Committee is comprised of the chairmen of the VREW workgroups, members of the Steering Committee, and selected personnel from the Technology Development Centers. It meets annually to examine project proposals. Proposals originate from a variety of sources including surveys of field personnel, spin-offs from previous development work, and suggestions from researchers, ranchers, or other interested individuals.

The workgroups are responsible for developing project proposals, monitoring progress, directing field testing, evaluating results and discussing new developments in their areas of interest. Each workgroup also reports its activities to the entire VREW organization during the annual meetings. These reports, along with papers presented during the meetings, are published every year.

VREW works very closely with the Forest Service Technology and Development Centers where most of the actual project work takes place. San Dimas and Missoula program leaders, project leaders, and support staff identify equipment needs; evaluate commercially available equipment; design, construct, and test equipment; and publish reports, films, and slide tapes and videos. In addition, they provide technical services that answer routine requests, maintain and update drawings and specifications, attend seminars and special courses, and determine the benefits and cost of equipment development projets.

VREW equipment development and test projects have encompassed a wide variety of needs. VREW achievements have resulted in effective and economic improvements of rangelands and critical watersheds. The interest, dedication, and cooperation among VREW members has produced a unique combination of knowledge, talent, and experience necessasry to meet the growing demand for range rehabilitation equipment and techniques.

Rangeland Drill

James A. Young, Range Scientist, USDA Agricultural Research, Reno, Nevada and Dan McKenzie, Mechanical Engineer, Equipment Development Center USDA Forest Service, San Dimas, California. **Reprinted from Rangelands 4(3), June 1982.**

The rangeland drill is an angular piece of towed equipment composed of impressively thick and heavy steel members carried on gargantuan steel rims and rubber tires. This is not a machine for drillilng holes in rangelands, but an implement for distributing seeds in furrows or drills. The seed-boxes on the top of the drill attest to its direct lineage from farm grain drills. The back of the drill consists of steel disks mounted independently on the end of structural steel arms attached to the bottom of the heavy steel frame. If the drill has been used recently, the disks are bright and shiny from the abrasive polishing received from rolling through rocky soils.

What is the purpose of this ungainly piece of equipment, who developed it, and what has been the impact of its use on the sagebrush/grasslands of western North America?

The Legacy of Misuse

The editor of the Carson City Morning Appeal must have felt especially clairvoyant on an early December day in 1886 as he greeted his readers with a stirring editorial offering an answer to the Silver State's declining range productivity. Let the state appropriate funds for the conducting of research to determine how to reseed the grasses on the depleted sagebrush ranges was his plea. The editor was at least 60 years ahead of the technology necessary to accomplish his goal on a large scale. Widespread grazing of cattle had been initiated on the sagebrush/grasslands of the Great Basin only two decades before the writing of the editorial, but already grazing of concentrations of cattle and horses in certain areas had depleted the perennial grass portion of the rangelands and allowed the nonpreferred shrubs to increase. The depletion was on a sufficient scale that it could be perceived by the editor of the sate capital's newspaper.

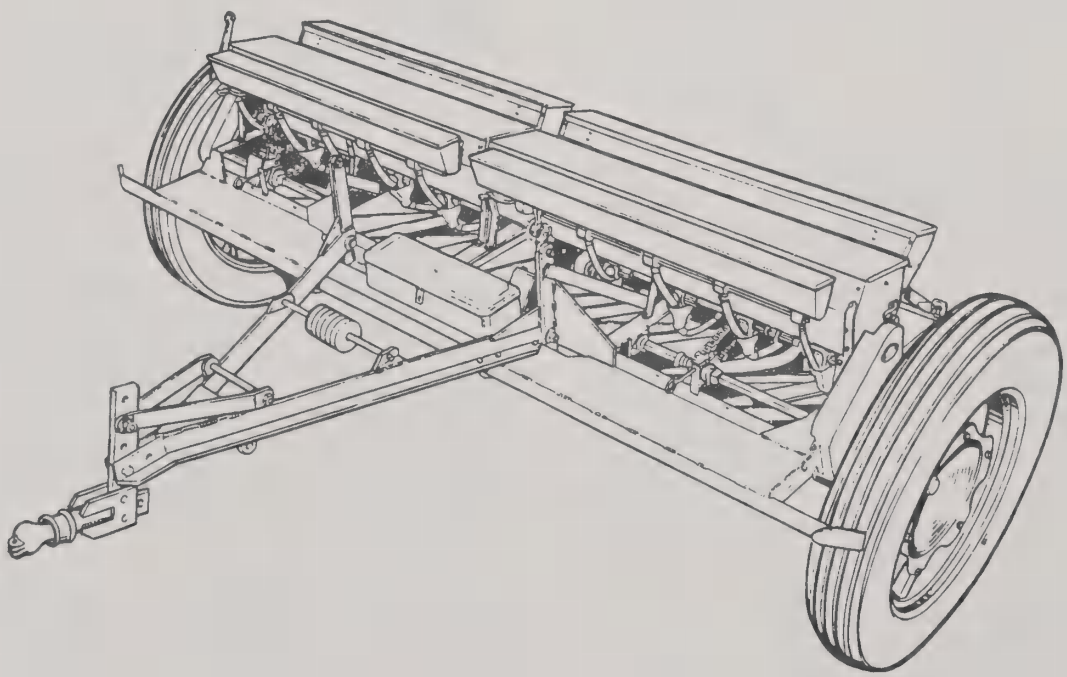
The impetus for reseeding degraded sagebrush came form two sources during the 1930's. First the long established research stations of the Forest Service, especially the Intermountain Forest and Range Experiment Station headquartered at Ogden, Utah, developed techniques for seeding sagebrush rangelands. Secondly, the infant Grazing Service of the Department of Interior began to instigate range improvement projects.

During the late 1930's a surplus of manpower was available through such programs as the Civilian Conservation Corps through such programs as the Civilian Conservation Corps (CCC) for improvement projects on public lands. For the first time the federal government was willing to spend considerable amounts of money toward improving wildlands. The CCC crews were employed on a variety of projects from building roads and trails to attempting to control the destructive outbreaks of Mormon crickets. Use of labor intensive methods for rehabilitation of degraded rangelands was defeated by the accumulations of woody biomass and the vastness of the sagebrush landscapes. A picture of futility was CCC boys pushing hand garden planters through mature stands of big sagebrush. These efforts were futile because of: (a) unreduced bilogical competition from the shrub, (b) the physical restrictions of pushing a handseeder through the shrubs, and (c) the limited area that could be seeded even with large crews.

Essentially the range rehabilitators were faced with the same problems that had plagued homesteaders. The successful homesteader within the sagebrush zone had sometimes overcome the shrub communities by developing water and flooding potential agronnomic fields. The native desert shrubs could not stand wet feet. Thousands of homesteads were cleared by hand grubbing, dragging with rails or timbers, or a combination of several such treatments. The range improvers did not have the option of flooding and, rather than a portion of 160 acres to clear, they had millions of acres of sagebrush to overcome and seed. The para-military CCC approached problems with a military attitude. More troops were futile, but the war against sagebrush would be more equal if suitable equipment could be substiuted for manpower. The logical source of equipment was agriculture, but generally agronomic tillage implements proved too fragile and time consuming to operate on sagebrush rangelands. Borrowing from the techniques used by developers of irrigation tracts, the CCC experimented with dragging heavy railroad rails behind tractors in an attempt to knock down or uproot mature, nonsprouting sagebrush plants. Several types of rails were developed for knocking down big sagebrush plants. These include the Monte Cristo rail, named for the Monte Cristo Ranger District in the Wasatch National Forest, near Ogden, Utah; the Olson rail, named for a sheep and wheat rancher who developed and extensively used the rail for clearing land of sagebrush in the Columbia Basin north of Hanford, Washington; and the Supp rail developed by the Supp brothers to clear land in the defunct irrigation project at Metropolis, Elko County, Nevada.

These early attempts at seeding sagebrush rangelands met with varying success. Most of the labor intensive efforts of the CCC ended in failure. Efforts to revegetate abandoned cropland were more successful. In 1936 the Rural Resettlement Administration began drilling the first of 57,000 acres of crested wheatgrasses on land utilization projects in Curlew and Black Pine Valleys in Oneida County, Idaho. The Crooked River National Grassland in central Oregon on the east side of the Cascade Mountains was another center of successful seeding establishment. Crews of local farmers were assembled in 1936 under the Emergency Relief Act as administered by The Rural Resettlement Administration to begin seeding abandoned cropland. The farmers brought their own teams and old farm tractors to pull disks, mold-board plows, and to seed with grain drills. A variety of species were seeded before crested wheatgrass became more or less the standard species.

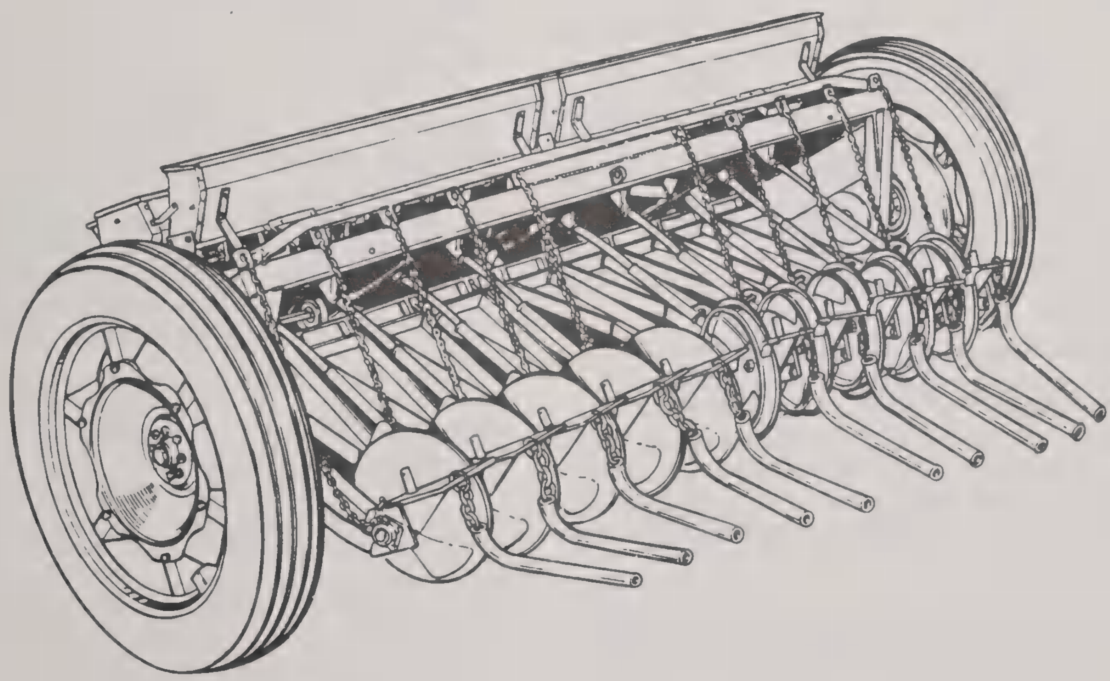
Private ranchers also experimented with seeding sagebrush rangelands. In 1940 there were three successful stands of crested wheatgrass on rangelands in Nevada and they all were located on private ranches and not on public rangelands. During World War II pressure was applied to the Forest Service by wool and meat processers to allow increased numbers of cattle and sheep to graze on National Forests. Remembering the disasterous results of such increased allocations during World War I, the Forest Service resisted such efforts, but pointed out that livestock production could be increased on National Forests in the West if degraded areas were improved through reseeding. With the support of the agricultural portions of the War Production Boards the Forest Service submitted supplemental budget requests for research on range reseeding. The Forest Service seeded about 20,000 acres in scattered plots throughout the West in this pilot program and, with the support of livestock producers, funding was greatly increased by Congress.



Rangeland Drill (front view).

As a part of the Forest Service range improvement program, Joseph Robertson was assigned by the Intermountain Forest and Range Experiment Station during the early 1940's to assess seedable sites on National Forests in Nevada and Wyoming. In the Ruby Mountains of northeastern Nevada, Robertson suggested the rugged topography, rocky soils, and general condition of the plant communities made seeding unfeasible and undesirable. Robertson suggested that the seeding of degraded sagebrush ranges located off the National Forest would benefit the National Forest ranges by permitting a later turnout data. His suggestion was accepted and 820 acres were seeded in the Ruby Valley near Arthur. For many years the seeded area had been a dangerous spring range for cattle because of low larkspur. Its grazing capacity was rated at 16 acres per AUM. The seeded area was a mixture of private and public lands administered by the Bureau of Land Management. After 2 years rest, the seeding was grazed for 3 weeks each spring by 400 cows and calves that normally would have been turned out on the National Forest. This example of how the seeding money was spent by the Forest Service illustrated the potential of range improvement to alleviate management problems while increasing red meat production. This and other pilot testing projects done during the war helped dispel the prevailing attitude that sagebrush ranges could not be seeded.

The Forest Service claimed a 90-percent successful establishment program with the pilot seeding program, but equipment breakage was a major problem. This led directly to the formation of the Range Seeding Equipment Committee. A conference was held in Utah in 1945 which was attended by the western Forest Service administrators and researchers to consider the general subject of range seeding. A lack of effective and suitable equipment was determined to be one of the major stumbling blocks in the way of successful seeding. Other land management agencies with similar problems eventually led to a committee for Range Seeding Equipment of federal interagency compositoin.



Rangeland Drill (rear view).

The committee was composed exclusively of Forest Service personnel for the first 2 or 3 years. The first official meeting was held in Portland, Ore., in December 1946. The second meeting followed in Ogden, Utah, in 1947. The list of those attending included a blend of old-time range scientists such as George Stewart and W.R. Chapline and such younger scientists as A.C. Hull and Joe Pechanec. Pechanec was elected chairman of the commitee. He was midway in his careeer as a scientist at this time and was to have a great deal to do with the development of special range improvement equipment both as a scientist and a research administrator.

The Bureau of Land Management, U.S. Department of Interior, joined the committee in 1949, followed by the Bureau of Indian Affairs (USDI) and the Soil Conservation Service (USDA). In 1954 after a portion of the ranch researach program was transferred from the Forest Service to the Agriculture Research Service (ARS), USDA, the ARS scientists joined the committee.

Brushland Plow

As previously noted, most of the wheatgrass seedings during the 1930's in the Intermountain area were carried out on abandoned cropland. If sagebrush ranges were to be successfully reseeded, mechanical means of brush control had to be developed. Among the first projects undertaken by the Range Seeding Equipment Committee was evaluation of the previously mentioned rail drags and pipe harrows for brush control. Both implements were relatively effective on old growth plants which could be easily uprooted, but did not control supple young plants.

The implement that did the best job of controlling big sagebrush was the wheatland disk plow. The wheatland plows were subject to a great deal of breakage of castings, disk, and even the frame if they were used on rocky sites. Use of this plow required continued maintenance. Despite its drawbacks many early seedings, including a portion of the Ruby Valley project, were established with wheatland plows with seeders attached.

After his experience with wheatland plows, J.H. Robertson was interested in the development of a plow for rangelands. He included in the proceedings of the 1939 World Wheat Congress a report on an Australian stump-jump-plow. The plow was designed with each pair of disks independently suspended on spring-loaded arms so that when an obstruction was met, the disks rode over the blockage and did not break. Robertson called this plow to the attention of his colleagues and, after a delay, a plow was imported from H.V. McKay, Massey Harris Ltd., Sunshine, Australia, and was known as the Sungeneral or Australia stump-jump-plow.

This plow was tested March 17, 1947, on an area south of Boise, Idaho. A portion of this site had lava rocks up to 16 inches in diametaer on the soil surface. Following the initial test, the plow was taken to an area near Smith Prarie in the Boise National Forest where 305 rocky and steep acres were plowed. The site had previously caused excessive breakage when it was plowed with a wheatland plow. Extensive testing of the plow in the Pacific Northwest was conducted. The original plow proved too weak and was subject to extensive breakage.

From this prototype plow imported from Australia the Range Seeding Equipment Company and the Forest Service Equipment Laboratory at Portland, Oregon, developed in 1947 and 1948 the plow which became known as the brushland plow. The engineering work was done by Ted Flynn with assistance from Tom Coldwell and with the approval of J.F. Pechanec.

Land managers now had an implement capable of attacking dense stands of big sagebrush. The plow imported from Australia was relatively inexpensive, costing $413 f.o.b., Sunshine, Australia, in 1947 and weighing 3,000 pounds. The brushland plow produced by the Equipment Development Committee's efforts was a much more substantial implement weighing 6,000 pounds. The brushland plow was considerably more expensive and the cost has continued to rise until now it has reached $25,000 (1979 prices). This underscores the capital requirements for range improvement.

The brushland plow is important in the story of the development of the rangeland drill because it was a necessary brush control implement to reduce competition for a drill to be effective and because the independent suspension of disks became roughly copied in the development of openers for the drill.

Rangeland Drill

Grain drills designed for farms had proven even less adapted to sagebrush ranges than plows. In southern Idaho and central Oregon there were considerable acreages of abandoned cropland that could be seeded to crested wheatgrass by grain drills with limited problems. However, the uneven seedbeds with clumps of woody trash produced by the new brushland plows proved to be particularly hard on grain drills. A major problem was breakage caused by the presence of large rocks in the seedbed.

In the early summer of 1951 Floyd Iverson, who was Regional Range and Wildlife Officer for the Forest Service, headquartered at Portland, Oregon, made a routine trip to the Fremont National Forest in southeastern Oregon. During a discussion of the range seeding program on the forest, the Forest, Range and Wildlife staff officer, John Kucera,

mentioned that during an 8-hour working day they were breaking three or four drill arm assemblies. Mr. Iverson "allowed" he would like to see someone develop a drill for rangelands. Kucera immediately said he would attempt such a development if he had the funds. The Regional office contributed $700 toward such a project based on Kucera's cost estimate. The drill conversion eventually cost $1,000 with the Forest paying the difference.

Development of the first drill was started in July 1950 (Table 1). For a performance goal it was decided to build a drill that could be used anywhere you could drive a small crawler tractor. Up until that time most range seeding was done with John Deere-Van Brunt grain drills. The Fremont Forest happened to have a Minneapolis-Moline drill with a heavy frame so it became the experimental unit. To gain clearance, 12-inch spoke extenders were welded around the existing wheels. This prompted taunts that the experimenters were building a mechanical porcupine. A new rim was placed around the outside of the spokes. The designers then developed Y yokes to support the disk openers. These openers made the furrow in the seedbed surface into which the seeds are dropped. The correct angle of these yokes to permit them to ride up over obstructions was determined by trial-and-error.

The nemesis of the commercial grain drills had been breakage of the castings that attached the disk openers. This breakage was caused by side thrust as the disk dug into the seedbed. Kucera and his crew solved this problem with larger, cold-rolled steel shafts and welded plates to support the self-aligning bearings. Again, it was necessary to establish the correct angle of the disk for optimum penetration in the soil on a trial-and-error basis.

Once the flexible opener assembly was designed, it was necessary to design a boot that would collect seeds as they were metered from the drill box and convey them to the openers. Working after-hours with blacksmith tools, Kucera finally succeeded in fabricating an acceptable metal boot which was connected to the opener with a rubber hose.

These are only the major modifications accomplished by the intrepid Fremont Forest designers. A host of other points ranging from chains to raise the opener's arms to weights to make the openers dig into the ground had to be considered and solved. Lakeview, Oregon, is not an industrial center where material or design advice was readily available. Remember, there were 10 openers and the drill; so, once a modification was perfected by trial and error, the designers had to make nine duplicates without drawings, templates, or jigs.

In the fall of 1951 the modified drill was used to seed 750 acres on the Coffee Pot seeding in the Paisley Ranger District of the Fremont Forest. The openers worked adequately, but it was necessary to strengthen the frame and tongue. In early January the designers loaded what they called "our monstrosity" on a railcar for shipment to the Forest Service Equipment Development Laboratory at Arcadia, California, where it was to serve as a model for development of an engineered drill.

The Range Seeding Equipment Committee adopted the rangland drill as a project in 1951. Tom Coldwell from the Forest Service Equipment Development Center visited the Fremont Forest and saw the Kucera drill and was instrumental in having the drill shipped to Arcadia.

The development of the rangeland drill now passed form a conceptual and demonstration-that-the-idea-was-practical phase to a full-scale engineering and development phase. From June 1951 to October 1952 Tom Coldwell directed the detailed engineering studies necessary to develop a prototype drill. On October 7, 1952, a full-scale engineering prototype rolled out of the shops at Arcadia. The prototype drill was sent for testing to the Fremont Forest where it is still in use.

During May 1954 a technical data package for the rangeland drill was released by the Equipment Development Center of the Forest Service. This package contained detailed drawings and specifications that permitted its manufacture by commercial firms. The production phase was initiated when the first commercially manufactured drill rolled out of the fabrication facilities of Laird Welding and Manufacturing Works at Merced, California, on April 29, 1955. This drill had been purchased by the Forest Service under contract and was shipped to Reno, Nevada.

The original drill certainly was not perfect. Over the years many modifications and attachments have been added. The major product improvement has been the addition of deep furrow openers. The disks of the original model drill were equipped with metal bands to prevent them from digging into seedbed and burying small grass seeds too deep. Users in the field soon discovered that in many conditions it was desirable to have the maximum amount of penetration and to plant the grass seed in a small furrow. Joseph M. Mohan was working in the Fremont National Forest when the first drill was being developed. Later in his career Mohan and Bill Currier decided to undertake a do-it-yourself program to modify the drill openers so they would make deep furrows. Mohan and Currier started with simple changes such as removing the depth bands and adding weights and worked up to cutting off the openers and changing the angle of the disk into planes.

Table 1.–*Development Life of the Rangeland Drill*

Exploration of Alternative Concepts Phase

1946-1950	Range Seeding Equipment Committee tested farm equipment and considered concepts.

Demonstration and Validation Phase

1951	John Kucera, Fremont National Forest, designed and built demonstration model of Rangeland Drill and field tested unit, validating design.

Full-Scale Engineering Development Phase

June 1951	Tom Coldwell, U.S. Forest Service, Arcadia Equipment Development Center (AEDC), visited Fremont National Forest to investigate Kucera's demonstration model Rangeland Drill.
June 1951-October 1952	Prototype Rangeland Drill on Fremont National Forest for field testing.
May 1954	Technical Data Package (drawings and specification) completed and furnished to contracting by AEDC.

Production, Use, and Product Improvement Phase

April 1955	First production Rangeland Drill completed by Laird Welding and Manufacturing Works, Merced, California, and shipped to U.S. Forest Service, Reno, Nevada.
1959	Work done by Forest Service in Washington and Oregon (R-6) on deep furrowing arms.
1960	A hinged fold over drawbar and acreage meter add, part stockage for Rangeland Drill and Brushland Plow established at USFS Equipment Depot, Stockton, California. John Deere discontinued production of B 20 X 6 grain box, grain box replaced on Rangeland Drill by John Deere Model PD 10 X 6, fertilizer and grass seed attachments now also available.
1964	Parts manual for Rangeland Drill completed, printed and distributed.
1966	Hinged-type drawbar and parking stand designed, and *Rangeland Drill Operators, Service, and Parts* Manual completed.
1967	Hinged drawbar and parking stand successfully field tested.
1968	John Deere discontinued production of PD 10 X 6 grain box, John Deere B 206 B grain box selected for replacement. New drawings completed for Rangeland Drill.
1969	Two experimental deep furrowing arms field tested by BLM, Elko, Nevada.
1970	Six redesigned deep furrowing arms fabricated and field tested by BLM, Elko, Nevada.
1971	Adjustable deep furrowing arms designed, two fabricated and field tested by BLM, Elko, Nevada.
1972	Three production prototype adjustable deep furrowing arms, with design changes, fabricated and successfully field tested, Lincoln National Forest, Alamogordo, New Mexico. Adjustable deep furrowing arms available as option in the technical data package.
1973	Rangeland Drills with adjustable deep furrowing arms used to seed 4100 acres in Idaho and Oregon.
1974	John Deere discontinued B 206 B grain box production. Also, 9.00 X 36 tire no longer available replaced by 11.25 X 28 tires.
1975	"Rangeland Drill Operations" completed [redacted] BLM Technical Note 289, Forest Service Equipment Development Center, San Dimas, California, assisted Laird Welding and Manufacturing Works, Merced, California, in mounting [redacted] John Deere 8250 series grain box on Rangeland Drill, technical data package not updated.
1976	Seed box capable of metering trashy seed tested on USDA/ARS Jornada Experimental Range, Las Cruces, New Mexico.
1977	Oilite and steel bushing bearing in opener arms replaced with triple seal, nonlubricating ball bearings, by Laird Welding and Manufacturing Works.
1978	Hydraulic operated opener arms lift attachment designed and available from Laird Welding and Manfacturing Works.

At the same time land managears were experimenting with modifications of the drill, scientists were defining the environmental parameters of deep furrows that resulted in improved seeding establishment. It was determined that furrows allowed earlier germination permitting more growth and a better chance of seedling establishment before soil moisture was exhausted by summer drought.

The scientists (Richard E. Eckert, Jr. and Raymond A. Evans, Agricultural Research, USDA) and land manager (Jerry Asher, BLM) combined in an appeal to the Range Seeding Equipment Committee for development of an engineered deep furrow arm for the drill. The committee adopted this project in 1969. Engineered deep furrow arms were developed under the direction of Dan McKenzie of the Equipment Development Center of the Forest Service. These arms were field tested and finally adopted as an option in 1972. Large-scale testing indicated conditions of vegetation cover and soil texture, moisture, or freezing required adjustment to the angles once or twice a week.

Not only was the drill modified to become more functional, the availability of the drill modified technology. When Kucera originally visualized the rangeland drill, he contemplated a piece of equipment which could be used to seed grasses in standing sagebrush. He planned to reduce competition by killing the brush with an application of the herbicide 2,4-D (2,4-dichlorophenoxy) acetic acid). This herbicide was being widely used to control sagebrush where sufficient perennial grasses remained preempting the environmental potential released by killing the shrub. Joe Mohan and Bill Currier perfected this technique in the late 1950's and B.L. Kay and Jim Street, working on sagebrush ranges located on the Likely Table lands in northeastern California, evaluated this vertical integration of these technologies in experiments.

It is not enough to conceive, develop, and produce a technological advance such as the rangeland drill. In order for users to fully benefit from the advance it is necessary to develop an operational manual and a parts list for the drill.

The rangeland drill is an inanimate hunk of steel, but its continued development reflects changing land uses. Currently the drill boxes can be furnished with double shaft agitators to aid in seeding trashy native grasss seeds on strip mine reclamation sites.

Significance of Rangeland Drill

Since the prototype drill was developed, approximately 320 drills have been manufactured for use in the United States and for export. As technological developments to accomplish specific jobs, the brushland plow and rangeland drill must be given the highest marks for ingenuity and technical engineering. The method of development with ideas born of need in the field being fed through a functional, interagency committee to be interacted on by engineers and biological scientists also deserves the highest praise. Although the rangeland drill was developed largely by agencies of the federal government, acutal manufacturing of the equipment has always been accomplished by private enterprises. It should be recognized that the development of highly specialized and very costly pieces of equipment have created very high capital requirements for range improvement. The cost of this equipment may be excessive for private ranchers unless they band together in cooperative units.

The rangeland drill is a symbol of a subtle change in the evolution of technology that occurred after World War II. The rangeland drill was conceived, developed, engineered, and largely used by the federal bureaucracy. Because the federal employees involved believed the volume of drills built would not justify the cost of obtaining patents, they did not pursue this documentation of their contribution; as a result the evolution of the rangeland drill was free of lawsuit. This is a sharp contrast to the initial development of machines for agriculture where the rights for virtually every innovation were contested in the courts for years.

The application of the post-World War II technology in range improvement was startling in its results. Using the sagebrush ranges of Nevada as an example, we find that about 1 million of the 27 million acres of sagebrush rangeland were seeded. This seeded area, that constitutes 2 percent of the total rangeland in Nevada, produces 10 percent of the harvestatble AUM's (Animal Unit Months) of grazing. The crested wheatgrass seedings produced early spring grazing on a sustained basis. Early spring is especially valuable to the livestock industry and is the period when native forage species are most susceptible to damage by excessive grazing. The successful seeding of wheatgrasses on degraded sagebrush ranges helped stabilize the livestock industry and added a new dimension to range management in the Intermountain West. On the other hand the acreage estimate of crested wheatgrass in Nevada was produced by planimetering the outline of angular wheatgrass seedings on imagery reconstituted from data collected from a stellite orbiting 500 miles above the earth's surface. A mere 320 machines have changed the appearance of planet earth as viewed from space. Obvious type conversions from degraded silver-gray brush to golden wheatgrass are visible to the general public. Environmentally concerned individuals have often protested such conversions as damaging to visual, wildlife, and cultural resources. Appropriate application of the range improvement technology can enhance and protect all of these resources and this is the challenge of wildland managers in the next decade.

The Rangeland Drill

John R. Laird, President,
Laird Welding & Mfg Works
Merced, California

Laird Welding & Mfg Works was established in 1937 by my father, Royal B. Laird. Mr. Laird was one of the first commercial members to attend VREW meetings.

1955 We were awarded the first contract to fabricate 20 Rangeland Drills for delivery to various parts of the western United States.

1959 The first deep furrowing arms were built by Laird.

1960 The hinged fold-over draw bar tongue became a part of the newer model Rangeland Drill. John Deere model B boxes were discontinued and replaced with model PD grain boxes, and grass seed and fertrilizer boxes became available.

1966 Hinge type hitches became part of the new drills, and parking stands were added.

1968 John Deere model PD grain boxes were discontinued and replaced by the model BB. now fabricated by Laird. (since 1974)

1968
1972 Deep furrowing arms were field tested in various areas, with about 5,200 acres planted.

1975 John Deere 8250 series grain boxes were mounted on Rangeland Drills.

1977 Disc shaft bearings were replaced with the Try-Ply (triple seal) non-lubricating type.

1978 Hydraulic lift attachment for the disc opener arms was designed by and available from Larid.

1980 The folding arms were fabricated from rectangular tubing instead of channel.

1981 Grain, grass seed, and fertilizer boxes were reinforced with heavier legs and angle braces.

As you can see,, many modifications and improved attachments for the Rangeland Drill have been made over the years, with the approval of the U.S.F.S. engineering office at the San Dimas Experimental Center.

The cost of building our Rangeland Drill has increased dramatically in the last 3 to 5 years, with no significant increase in the price of our drill and its options. This will probably not be the case much longer, as the cost of component parts, product liability, and labor are extremely high and continue to rise. The Rangeland Drill is a low volume product, and we therefore have a large capital outlay for purchased components for 2 to 3 years in advance. This situation limits the amount we have been able to spend on experimentation.

Hopefully, the need for Rangeland improvements will be recognized and dealt with in a way beneficial to everyone concerned.

Garrison Seed

**Key Crawford, Garrison Seed & Co, Inc.,
Hereford, Texas**

During the past couple of years, the seed industry has been under heavy pressure trying to furnish grass seed for the needs of the Conservation Reserve Program.

Grass seed prices have risen dramatically to new highs because of large demand and short supplies. These lucrative markets have given birth to many new small grass seed companies and independent suppliers.

At this time, the first rush of CRP planting is over, and the demand has decreased to a point where the high prices of a year ago are showing some signs of erosion.

If one is to look closely at the history of prices during the Soil Bank program of the late 1950's, which seems to have many similarities, you can deduce that prices could decline to a point where there would be some very good bargains available in grass seed. Although we at Garrison seed do not expect sharp declines in prices to occur in the near future, we cannot discount that possibility.

If prices decline to pre-CRP levels, it is not known how many of the newer grass seed companies and independent suppliers will remain in business. We at Garrison Seed would like to assure you that we will still be producing and selling varieties of native grass after CRP as we have done for the past twenty plus years.

Prior to CRP, Garrison Seed had approximately 600 acares of native grass seed production in mostly irrigated blocks. This production was made up of improved selections coming from the Plant Material Centers of varieties such as: Blue Grama, selections Hachita and Lovington; Sideoats Grama, selections Haskell and Gaughn; Galleta, selection Viva, to name a few. During the CRP, additional plantings were made to help cover the increased demand. As the CRP demand decreases, it is anticipated that the additional plantings will revert to other irrigated crops, but we will maintain our original production which came from foundation seed.

We do not believe that the excellent work done by the Plant Materials Centers should be ignored. We feel that the selections that they have proven to be superior should be utilized by the seed companies. At this time, we are continuing to increase our production from foundation seed.

We at Garrison Seed believe that by reproducing seed from improved selections and using our State's certification process we can produce a top quality seed for our consumers.

We believe that being present and having the capability to assist customers with their problems, as well as furnishing a top quality product, is what makes a good seed company.

Garrison Seed plans to be a good seed company.

Sharp Bros. Seed Co.

Art Armbrust, Sharp Bros. Seed Co., Healy, Kansas

Sharp Bros. Seed Company made a presentation showing native grass seed production, specialized conditioning and harvesting equipment for both warm and cool season grasses. Slides showed the operations at Healy, Kansas; Greeley, Colorado; Amarillo, Texas; and Clinton, Missouri. Key people who work in these operations were presented.

Discussion of the presentation stressed the importance of the improved native and introduced grasses.

History of Ag-Renewal

Weldon Miller, President
Ag-Renewal Inc.
1710 Airport Road
Weatherford, Oklahoma

I am pleased to introduce you to AG-Renewal, Inc., a rapidly growing company providing quality goods and services to forage producers to help them better manage their forage businesses.

The history of Ag-Renewal, Inc. is typical of many farmer businesses in that a series of farm business decisions led to a full-time farm agribusiness.

1975 — R.L. Dalrymple, Agronomist with Noble Foundation of Ardmore, Oklahoma, asked my dad, Glen Miller, to plant Plains Bluestem grass on land we rented from his mother. We harvested the seed annually with the conventional, but highly inefficient, "combine" method through 1981.

1981 — In September, we went to a field day at the USDA-ARS research station at Woodward, Oklahoma, where they introduced a new method of harvesting grass seed with Woodward Flail-Vac Seed Stripper. In December, we obtained the license to manufacture and sell the patented Woodward Flail-Vac Seed Stripper from Aaron Beisel, a farmer-inventor.

1982 — We manufactured and sold the Woodward Flail-Vac Seed Stripper under a partnership named Ag-Renewal Group, which was later incorporated and renamed Ag-Renewal, Inc.

1987 — Operations were moved from the farm to a facility in Weatherford, Oklahoma.

Plant Materials and Equipment

The rest of my presentation will be on plant materials and equipment that research facilities have developed and the resulting commercial applications.

Pneumatic - Seed Shucker

The Pneumatic Seed Shucker was invented by Aaron Beisel, Fargo, Oklahoma, working with the USDA-ARS in Woodward, Oklahoma. Due to unknown purity levels of chaffy seeds, the shucker is needed to take the guess work out of grass seed harvesting, cleaning, and marketing. Use it as a tool to determine within several minutes if fields are worth harvesting, if seed offered to you is at the claimed purity level and, while cleaning seed, to monitor the cleanout.

The 23-inch aluminum seed shucker attaches to your compressor and operates at 90 psi, furnishing 7 cfm to produce a supersonic blast which strips the chaff from the grain. Seeds not completely shucked are recycled until shucking is finished. Clean grain exits the unit against a vacuum resistance which holds the light trash within the shucker.

Hi-Intensity Scalper Seed Cleaner
With Fluidic Seed Classifier

The rotating aluminum basket is a combination precleaner and feeder. As the basket rotates, small sticks, miscellaneous debris, seed, and chaff fall evenly on the sieve.

The hi-intensity vibration separates the sticks from the other material as the sticks fall off the front. The seed and other lightweight debris drops through the sieve and is transferred pneumatically from the Hi-Intensity Scalper to the Fluidic Seed Classifier. The momentum of the good heavy matuare seed carried it into the further chute where it falls into the bag. The immature seed, dust, and chaff, given a lower momentum, falls into the nearest chute where it is blown out to a trailer for disposal.

Seed cleaned by this system is of the highest quality. The seed with low seedling vigor and poor germination is isolated and removed by the Fluidic Seed Classifier. Bagged clean seed from this system will carry a quality reputation and demand a premium price.

The operation is air operated, and electric motors are not needed providing for safety factor due to dust explosion potential. The control panel allows easy adjustment of gauges and valves to monitor and guide the following:

1. Basket Speed
2. Sieve Vibration
3. Transvector — to transfer seed

Old World Bluestem Grass Seed

In the lates 1940's, researchers traveled to the Old World (Iran, Pakistan, Afghanistan, Turkey, etc.) to gather seeds from plants growing in that area. These grasses had been through thousands of years of abuse (drought, over-grazing, etc.). In

1971, after a decade of research, Oklahoma State University released Plains Bluestem. In 1979, Ganada was released from New Mexico, with most of the work being done at the United States Department of Agriculture, Soil Conservation Service, Plant Materials Center at Los Lunas, New Mexico. In 1981, Spar Bluestem was released by the United States Department of Agriculture, Agricultural Research Station in Woodward, Oklahoma.

The above three grasses are marketed by AG-Renewal. Two other Old World Bluestems (OWB) are: T-587, developed at the USDA-SCS, Plant Materials Center in Knox City Texas, and Ironmaster, developed by the USDA-ARS at Woodward, Oklahoma.

The commercial application of these plant materials has been significant. If we used the Conservation Reserve Program (CRPP) in Oklahoma, Texas, New Mexico, and Colorado as an example, and figure that 1 million acres have been planted to these grasses, there is a $20/acre savings in seed costs compared to the cost of native grass seeds. With 50 percent cost share, there is a resulting $20 million of savings with $10 million of that savings going to the Federal Government and $10 million to the farmer. With this example, we can see how the government got a $10 million return on their small investment in basic research.

One concern of CRP is what happens after 10 years. I believe that a higher percentage of land that is planted to these OWBs will stay in grass compared to land planted to other grasses. I base that on the excellent grazing results and the wide acceptance of these grasses before CRP. At the Amarillo Farm Show in December, 1988, 50 percent of the interest in these grasses was for non-CRP purposes, indicating great acceptance of these grasses. The use of these plant materials has been significant and with profitable commercial application.

Woodward Flail-Vac Seed Stripper

The Flail-Vac is a rotary brush stripper which attaches to a tractor's front-end loader. The brush creates a vacuum, drawing the seed head in while stripping the ripe seed and depositing it in the hopper. Flail-Vac's harvest only the ripe seed, leaving immature seeds for later harvesting. An independent PTO-driven hydraulic system provides variable power, up to 900 RPM for optimal brush speed, for harvesting a wide variety of grass seeds. Many cool season grass seeds such as Fescue, Kentucky Bluegrass, and others can also be harvested with the Flail-Vac. The Flail-Vac was invented by Aaron Beisel, Fargo, Oklahoma, working with the USDA-ARS in Woodward.

Models Available:

FV-6: 6-foot wide stripper (mainly for small research plots).

FV 12: 12-foot wide stripper.

New for 1989:

Optional brush — bigger bristles and higher speed for harvesting practically any crop.

Commercial Application

Example: 200 Flail-Vacs at 10,000 PLS lbs. each = 2 million lbs. at $14/lb = $28 million.

If we use the accepted practice of saving that this money turns over seven times, it is easy to see that the Flail-Vac has had a significant impact on the little towns of Oklahoma and Texas. When you combine that $28 million with the $10 million in savings, that comes to a total of $38 million, which in turn is turned over seven times, which comes to a significant figure.

Other Ues of the Flail-Vac

1. University Research Facilities

2. Soil Conservation Service — Plant Materials Centers

The two above like the Flail-Vac because of the easy clean-out between varieties, and it is simple and economical to operate.

In summary, these plant materials and equipment that have been developed at research facilities and thhat we at Ag-Renewal market, are good examples of the commercial applications resulting from basic research.

Arid Land Seeding

Harold T. Wiedemann, Chairman, Texas Agricultural Experiment Station, Vernon, Texas

The arid land seeding committee has been active in seedbed preparation using the disk-chain. Reports concerning its use and modification in Idaho, Utah, and Texas are included as individual reports.

Disk-Chain-Diking

A promising new device has been built to enhance grass establishment using the basin tillage (pitting) concept. The chain-diker was designed to conserve moisture and reduce runoff for dryland wheat; however, it appears well-suited for range seeding. It operates at 5 mph while forming 4-inch-deep basins about a foot apart (20,000/acre). Widths up to 90 feet are possible and very little maintenance or pulling power is required. When attached to the rear of the disk-chain, it improves operation of disks, smooths the roughly disked soil and then forms the dikes (basins). Preliminary results have shown significantly better grass stands for the disk-chain-diker than disk-chaining or smooth chaining alone. Bruce Smallacombe of Australia, invented the award-winning device for wheat farming using a concept similar to the disk-chain. For additional information, contact Harold Wiedemann, Texas Agricultural Experiment Station, POB 1658, Vernon, TX 76384.

Uinta Rangeland Drag

The Uinta Rangeland Drag was designed for rehabilitation of small acreage sites where it is uneconomical to utilize heavy equipment. It has been successfully used on sites such as tarweed flats, heavily used dispersed recreation areas, abandoned drill pads, campgrounds, old building and corral sites, and sheep bedgrounds. An average seedbed preparation of 2-3 inches of topsoil is generally achieved after dragging and then crossed again with the drag to cover the seed.

The drag was developed on the Uinta National Forest in cooperation with livestock permittees. It is highly versatile in that it is easily pulled by a standard two or four wheel drive pickup and it is easily assembled in the field using just a crescent wrench. Clevis connectors are used to connect various numbers of drag units depending on the project (Figure 1).

Figure 1.—A four unit drag.

Design and Materials

The drag is simple in design and easily constructed in an average warehouse or garage. Sidewalls are cut out of discarded heavy equipment tires using a hand-held reciprocating saw. Tires with a minimum ply of 24 are used. A minimum thickness of 24 ply is used to prevent ripping of the rubber.

Generally, these are tires used on large earth movers or front end loaders. In most cases, used tires can be obtained for no charge from construction companies on mining sites or highway construction projects. Holes are drilled through the sidewalls approximately 2 inches in from the outside edge and 3/4-inch steel rods, 1 foot in length, are then bolted through the sidewall to serve for scarifying. A simple pipe towbar is used to pull drag units which are chained together from front to back and from side to side. When in use, the advantage of the rubber sidewalls becomes quickly apparent. Due to the flexibility of the rubber the steel rods will slightly flex when contacting immovable material such as large rocks. This allows the drag to move over such obstacles without breaking or causing the pulling vehicle to lose traction. Maintenance costs of the drag are almost completely nonexistent because of this feature.

Figure 2.—Uinta Rangeland Drag can be transported in a pickup.

The cost of materials for constructing a four unit drag are as follows:

Item	Quantity	Price
Tire sidewalls-24 ply (min)	4	0
Steel rods - 3/4 in x 12 in	36 each	27.00
Nuts and Washers — 3/4 in	36 sets	36.00
Clevis connector	12 each	28.00
Chain — 5/16 in	25 feet	6200
Pipe towbar — 2 in x 8 ft	1 each	16.00
		169.00

Labor costs would include cutting out tire sidewalls, drilling out and bolting on steel rods, cutting chain, and welding chain onto towbar.

Advantages

- the drag is easily pulled by a 2 or 4 wheel drive vehicle (wheel drive if greater than 5 percent slope)
- one person job to load into bed of a pickup, transport, and assemble in the field (Figure 2)
- numerous sites in various locations can be treated during one work day
- economical to construct and maintain
- suitable to any terrain or slope that can be driven
- provides a small furrow for water-holding capability
- leaves existing perennial plants in place
- fast to use —sites can be criss-crossed for extra soil turning

Disadvantages

- less effective on extremely compacted clay soils (treat heavy clay soils when slightly moist)
- does not plow out unwanted vegetation.

For more information, contact:

Dave Myers
Heber Ranger District
P.O. Box 190
Heber City, UT 84032
(801) 654 0470

Prescribed Fire Ignition-Blowgun

Phil Range, Bureau of Land Management, Boise Interagency Fire Center, Boise, Idaho

Safety is a big concern when lighting large blocks of rangelands by hand or heavy timber fuels on steep slopes.

Three years ago, the BLM contracted with a company called Wildland Resource Management of Walnut Creek, California to develop a new ignition device for use on prescribed fires. The contract was for a proof of concept. Their device is called a Blowgun and was tested with great success. The Blowgun is composed of a launcher, fin-stabilized projectile containing the ignition system, and a compressed air source. Projectile propulsion is obtained from a standard air compresser.

The lightweight launcher will send the projectile over 300 yards. The launcher assembly consists of a pneumatic minature cannon. The projectiles contain sawdust, wax, and potassium permanganate. Ethglene glycol is added to the potassium permanganate. Ignition takes place in 20-40 seconds and ignites the entire projectile. It burns for less than 10 minutes and has a flame height less than 15 inches. Projectiles are non-explosive and non-toxic, and easy to transport. When he unit is fully developed, the BLM expects to reduce the number of employees required to light a burn, cut some costs, and improve safety.

Hopefully, in 1990 we will be able to extend this contract and have the Blowgun perfected and available for further testing.

Rehabilitation Equipment Development in Southern Idaho

Mike Pellant, USDI Bureau of Land Management, Idaho State Office, Boise, Idaho

The impacts of wildfires are one of the greatest resource management concerns on rangelands administered by the Bureau of Land Management (BLM) in southern Idaho. Equipment development and modifications are needed to implement a "greenstripping" program (establishing strips of fire resistant vegetation) and to improve shrub restoration practices. Described below are modifications recently made to the BLM's disk chain and a new sagebrush seeder and chain harrow.

Disk Chain Modifictions

Idaho BLM has been using a disk chain Pellant (1988) to prepare seedbed and plant perennial vegetation in cheatgrass dominated rangelands. Several modifications have been made to this original unit to correct deficiencies and to improve effectiveness. The chain link-to-disk ratio was two-to-one on the original unit. The distance between disks (36 inches) precluded a full turnover of surface soil, thus competition from undesisrable annual species was not adequately controlled. This problem was especially evident on sites where fall germination of annual species had not occurred and the soil was dry. Under these conditions the disk chain was only partially effective in reducing annual species competition.

The link-to-disk ratio has been inncreased to one-to-one with the addition of a disk to each chain link. Complete soil turnover is now achieved, improving control of annual species. However caution must be exercised in using the disk chain under moist soil conditions with abundant litter or shrub cover. Disks accumulate soil and debris to the point where the cutting action is greatly reduced. If the disk chain is used in burned areas without litter or debris, little accumulation of soil or litter occurs.

Other minor modifications to the disk chain have also been made. Wider V-shaped plates have been welded to the roller bar below the seed boxes to increase the area where seedbed compaction occurs. Corrugated seed tubes have been replaced with smooth seed tubes to reduce seed tube clogging. Finally, a "windscreen" has been installed behind the seedboxes to stop seed from blowing behind the roller bar.

Jarbidge Sagebrush Seeder

Recent attempts to reseed big sagebrush in critical wildlife habitat areas have been hampered by difficulties in distributing sagebrush seed over large acreages. BLM's Boise District has constructed a sagebrush seeder consisting of three components. An "EZ Flow" fertilizer seeder distributes sagebrush seed over a 12-foot wide strip. This spreader has good agitation, a large seed aperture size (1.75 inches) and no seed tubes to clog. Drag chains are pulled behind the fertilizer spreader to lightly cover the seed. Finally a vine roller cultipacker consisting of truck tires cemented to a solid shaft firms the seedbed.

This seeder can be pulled by a two-wheel drive tractor at a cost of $5 per acre for operation. Acceptable sagebrush establishment (1,900 and 17,000 plants per acare at an application rate of 0.7 pounds PLS per acre) was obtained on two projects seeded in the fall of 1987 (Boltz 1989).

Chain Harrow

Harrows are an effective technique to lightly cover seed on rangelands free of obstructions. However in areas with rock outcrops conventional harrows are easily damaged and of limited value. BLM's Boise District has constructed a chain harrow to solve this problem. This unit consists of a 54-foot wide elevated frame with 8-foot segments of 5/8-inch diameter chain attached at 4-inch intervals. The frame is mounted on truck tires and has sufficient clearance to pass over surface rocks up to 24 inches in height.

It can be pulled with a two-wheel drive tractor (60-80 horsepower) at operation speeds ranging from 2 to 6 miles per hour, depending on the amount of rock in the area. On a project with moderate amounts of rock outcrops, an average of 20 acres per hour was treated with the chain harrow. Soils were gravelly loams and dry at the time of treatment. A 1/2-inch deep furrow was created by each chain. On sites with soddy soil conditions, surface soil disturbance is minimal.

Total costs of labor and materials to construct the chain harrow was $8,500. Weight of the unit is 7,500 pounds. The chain harrow should have the greatest application on coarse soils or when light seed coverage is required.

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Boltz, Milchael. 1989. Dual seeding to establish grass and shrubs on burned sites in southwestern Idaho. In: Abstracts, 1989 Society for Range Management Annual Meeting, Billings MT.

Pellant, Mike. 1988. Use of disk chain on southern Idaho's annual rangeland. In: Vegetative Rehabilitation and Equipment Workshop: 42nd annual report, Corpus Christi, TX, p. 40.

A Variable Stroke Mechanism for Mechanical Water Pumping Windmills

F.Z. Kamand and R.N. Clark, Agricultural Engineers, Agricultural Research Service, Conservation and Production Research Laboratory, Bushland, Texas

Research at the USDA Conservation and Production Research Laboratory, Bushland, Texas, indicates that when a standard windmill is equipped with a variable stroke mechanism the water pumped could be doubled. Positive displacement pumps which are used with mechanical windmills have a fixed stroke length and require a constant operating torque from the windmill rotor. The available torque from the windmill rotor increases with windspeed squared. When the available rotor torque exceeds that of the load, the windmill rotor overspeeds almost in proportion to windspeed, thus not taking full advantage of the extra power available at the higher windspeeds. To better take advantage of the cubic relationship between windspeed and available power in the wind, the pumping load should be varied with windspeed. This can be accomplished by either varying the stroke length of the piston pump or by varying the gear ratio between the rotor and the pump. The most promising and practical approach to increase the pump discharge is to vary the stroke length of the pump in proportion to windspeed squared, thus improving the wind to water pumped conversion efficiency.

A variable stroke mechanism which automatically varies the stroke length of a positive displacement well cylinder as windspeed squared, was designed and field tested at the USDA, Agricultural Research Service, Conservation and Production Research Laboratory, Bushland, Texas. The mechanism uses two low pressure hydraulic cylinders to actuate the stroke control device. As windspeed increases, the stroke length increases, resulting in additional pumped water. As windspeed decreases below the cut-in windspeed for the standard windmill, the stroke length decreases below the standard length. Therefore, because of the reduced torque requirement, the windmill is allowed to operate at windspeeds below the cut-in windspeed for a standard windmill. Although little water is pumped with the shorter stroke length, this extra water can be very useful.

The variable stroke mechanism was field tested on one of two 8 foot Dempster windmills erected at the Bushland, Texas, Research Laboratory testing site; the second unit served as a control to compare the volumes of water pumped by a standard windmill under the same windspeed and pumping conditions. Data collected included windspeed and direction at hub height, volume of water pumped, pumping lift, stroke length and rate, and pump rod loadings. Results showed that the cut-in windspeed for the unit with the variable stroke was decreased by 3 to 5 mph depending on the pumping lift (30 to 100 ft). The windmill availability (pumping time) of the unit with the variable stroke was increased by an average of 10 percent during the test period. This increased availability took place between windspeeds of 17 to 13 mph, which is the start-stop hysteresis region of the windmill. The measured rated flow, which occurred at a windspeed of 22 mph, was indpendent of the pumping lift. The standard windmill had a rated low of 6.9 gpm while that of the variable stroke unit was 12.2 gpm. The average pumping rate of the windmill with the variable stroke was 3.4 gpm higher than the standard windmill for windspeeds between 13 mph and 38 mph (which is the shut-off (cut-off) windspeed. Annual water outputs calculated on the basis of the two pumping curves for the test site differed by approximately a factor of two.

Independent Wind Electric Water Pumping

R. Nolan Clark, Agricultural Engineer, USDA, Agricultural Research Service, Conservation and Production Research Laboratory, Bushland, Texas, and William E. Pinkerton and Joe W. McCarty, Alternative Energy Institute, West Texas State University, Canyon, Texas.

An independent wind electric system to provide the energy for pumping water offers several advantages over mechanical wind systems and solar systems. The wind turbine does not have to be located directly over the water source, thus allowing the selection of the best site for both the water supply and wind generator. Standard electric motors and pumps can be used with the electrical generating wind turbine. Experiments have been conducted by the USDA, Agricultural Research Service and the West Texas State University, Alternative Energy Institute to evaluate the performance of independent wind electric pumping systems.

A wind turbine with a permanent-magnet alternator was used to power standard three-phase induction motors connected to water pumps. The wind turbine was rated at 10 KW and produced a linear output of frequency between 30 and 90 Hz when alternator speed changed from 85 to 275 rpm. The alternator provided a frequency of 60 Hz at 21 mph windspeed. The alternator and motor impedances were matched using capacitors; thus increasing the voltage at each alternator speed. The amount of capacitance varied from motor to motor depending on the impedance of the electrical system.

Three pumping conditions were examined during these experiments. A low head, high volume pump was thoroughly tested at several capacitances and two pumping heads (15 ft and 50 ft). A high head, low volume pump was tested at 3 pumping heads (230, 290, and 345 ft) and one capacitance. A medium head, medium flow pump was tested at a single head and capacitance. The pump motor for the low head pump was a four-pole motor which operated a 1750 rpm at 60 Hz, while the other pump motors were two-pole motors operating at 3450 rpm at 60 Hz. Because of the variable frequency operation, the pumps operated between 900 and 2700 rpm for the four-pole motor, and 1800 and 5400 rpm for the two-pole motors.

The motors operated at near the same efficiency as when operated from utility power, but pump efficiency was reduced at high rpm when frequency exceeded 70 Hz. At high windspeeds, when the frequency exceeded 75 Hz, the windings in the electric motors produced more than normal heat and wind turbine output reached near 14 KW at 33 mph windspeed. The pump and motors were easily started at frequencies of 30 to 35 Hz (8 mph windspeed) and small amounts of water were pumped. The use of a variable-frequency, variable-voltage system expanded the useful operating range of the wind turbine and provided more water than mechanical wind systems.

Preventing Livestock Water From Freezing by the Use of Insulated Watering Tanks

Dan W. McKenzie, Mechanical Engeineer, USDA Forest Service, Technology and Development Center, San Dimas, California

In 1983 the Technology and Development Center prepared a report, Preventing Livestock Water From Freezing, in which one of the recommendations was, on an opportunity basis, to continue the market search for equipment and methods to prevent livestock water from freezing with new information reported in the VREW annual report. The Technology and Development Center has become aware of a commercial insulated livestock watering tank that appears to reduce the freezing of livestock water at low temperatures. This livestock watering tank is manufactured by:

Miraco
P.O. 686
Grinnell, Iowa 50112
(515) 236-5822 or (800 541-7866

The watering tank is supplied in two configurations and in a number of sizes. The two configurations are a large ball float opening and a lift-up lid design, primarily for use with hogs, sheep, and small cattle. Ten sizes are available ranging from 6 to 100 gallons. The company reports the tanks have been tested by the U.S. Bureau of Standards. The report from the Bureau of Standards states that the Miraco insulated tank will work as stated anywhere in the Continental United States with as few as 6 head of cattle drinking every other day.

Equipment Development and Test Funding

For many years the "Range Reseeding Committe" was an informal group, meeting each year to exchange information on work of mutual interest and to develop project proposals for work to be done by Equipment Development Center or field units. The proposals were written, estimated for cost, and finalized "on the spot." Informal, but it seemed to work!

Today there are demands being placed on us to plan in detail 2 years in advance, and in general 5 to 10 years ahead. This does take away some of the informality of the operation and dictates the need for a more organized approach to the preparation and submittal of project proposals. Figure 1 shows a plan by which we can meet our budgeting dates. It provides a mechanism whereby the Technology Development Centers can stay within the budget process of the Forest Service.

The other aspect of our planning procedures is a more uniform format for project proposals. Figure 2 is a suggested guideline for proposals. Following this guide will help all concerned in preparing and reviewing proposals. It should make the flow of information more efficient and provide a much better story for those who must analyze needs, prepare programs, and assign priorities.

We hope that everyone associated with the Vegetative Rehabilitation and Equipment Workshop will cooperate in this more formal approach. It should be an aid to everyone. If any questions arise or there is a need for help in this process, call the Centers or the Washington Office.

Project Proposal Processing

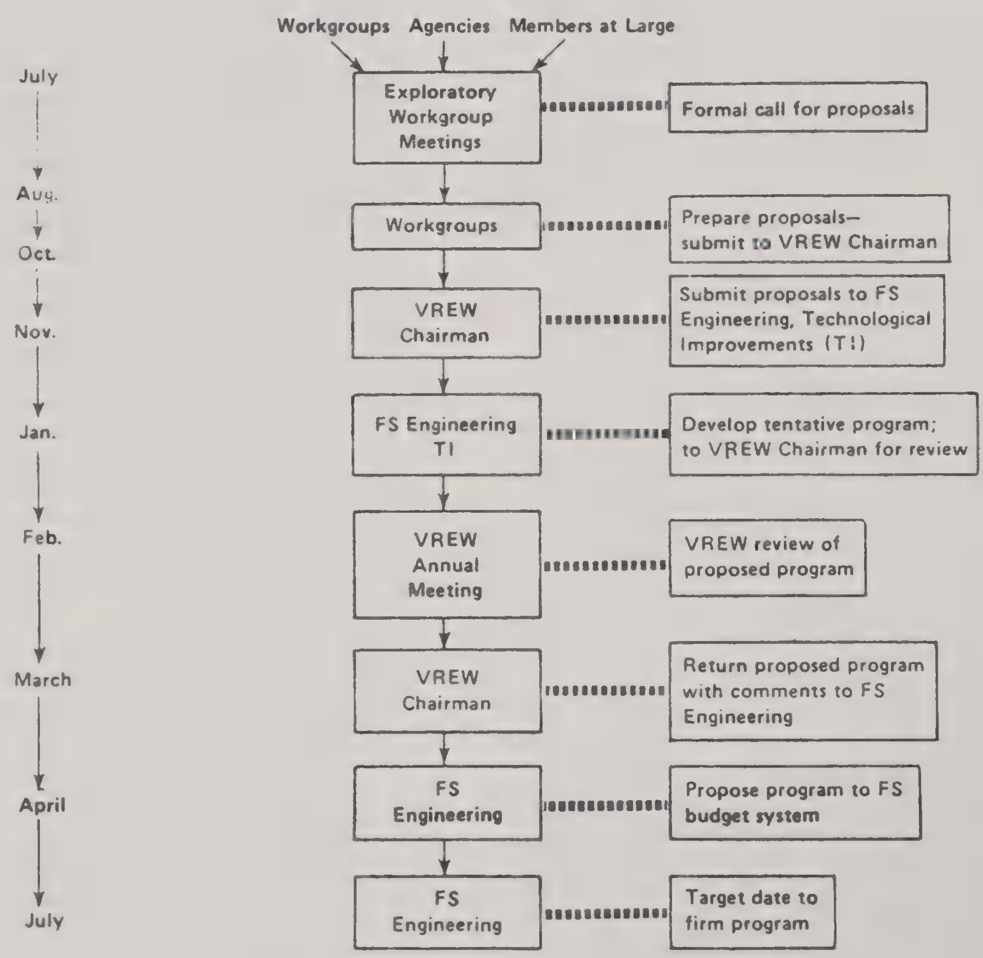

Figure 1.—Project proposal processing.

(Project Proposal Format)

Equipment Development and Test Project Proposal FY __________

ED&T Project No. (Leave Blank)
Date ____________________
Primary Interest: ____________

(Title)
- (The title should be brief and indicative of project objectives.)

Problem Statement and Overall Objectives

- *(State the problem and describe how the work is currently being done. Tell what equipment, materials, or methods are used, and why change or improvement is needed. Show significant advantages and potential savings, such as: increased production or efficiency, property or human hazard reduction, reduced maintenance, and public demand or reaction.)*

- *(State the overall objectives. What is to be accomplished or what is to be achieved by this project?)*

- *(Include amendments to the problem statement and overall objectives, if necessary for completion by the Development Centers for applicable continuing projects only . The statements of the original problem and objectives should not be changed. If there is a change in emphasis, add revised problem statements and objectives here.)*

Specific Requirements

- *(Distinguish between minimum requirements and those which are desired but not essential. Describe features required or specify performance characteristics. Where more information will be needed but cannot be furnished, list items that should be explored.)*

Prior Development

- *(Briefly describe work already completed or underway which is related to this project. On new projects, this work will generally have been done by other persons or organizations or under other equipment development projects. For a continuing project, tell when it started and briefly state major accomplishments, and actions planned for completion in the current fiscal year. Reference the overall project time frame and total cost estimate if previously made and if applicable, prior reports and publications.)*

Project Origin

- *(Show the name, organization, etc. of persons originating the project and preparing the project proposal.)*

Figure 2.—Format for project proposal.

Range Publications and Drawings

Below are titles of reports on a variety of range rehabilitation topics, as well as a list of range equipment fabrication drawings. These materials have been produced by the Forest Service Technology and Development Centers at Missoula (MTDC) and San Dimas (SDTDC) and may be of interest to workshop members. Single copies of the reports are available without charge by writing to the appropriate Center. Some drawings are available without cost also; there may be a small charge for others.

USDA Forest Service
Technology and Development Center
Bldg. 1, Fort Missoula
Missoula, MT 59801

USDA Forest Service
Technology and Development Center
444 East Bonita Ave
San Dimas, CA 91773

The list of publications includes **Equip Tips**, concise reports dealing with new equipment, new uses for equipment, and similar topics; **Equipment Development & Test (ED&T) Reports**, documenting major development studies; **Project Reports**, describing the technical details of development work, including procedures, results, conclusions, and recommendations; a number of **Special Reports**, ASAE papers and service manuals are listed under **Other Reports**.

Equip Tips

A Portable Power Platform for Forestry Tasks, June 1988—MTDC

Hammer-Action Hand Planter, May 1988—MTDC

Anchor Chain Scarifier, May 1988—MTDC

Improved Planting Auger, May 1988—MTDC

The Salmon Blade, May 1988—MTDC

Tractor-Mounted Scalpers for Site Preparation, April 1986—MTDC

Cable Scarifier for Site Preparation, April 1986—MTDC

Better Handtools for Site Preparation, Sept. 1985—MTDC

Hydraulic Post Puller, Aug. 1984—MTDC

Bitterroot Miniyarder for Light Forest Materials, May 1983—MTDC

Small Yarder for Steep Terrain, May 1981—MTDC

Resource Publications, Dec. 1980—MTDC

Proper Use of Fusees, Feb. 2980—MTDC

Improved Aerial Ignition System, Jan. 1980—MTDC

Protecting Western Conifer Seedlings, May 1979—MTDC

Steep-Slope Seeder for Roadside Slope Revegetation, Feb. 1979—SDTDC

Seed Dribblers (revision no. 1) July 19777—SDTDC

Spray Boom Assembly, July 1972—SDTDC

Plastic Pipe Laying Machinery, Jan. 1966—SDTDC

Browse Seeder with 20-inch Scalpers, Jan. 1965—SDTDC

ED&T Reports

Catalytic Converter Exhaust System Temperature Tests, Feb. 1977—SDTDC

Slash...Equipment and Methods for Treatment and Utilization, April 1975—SDTDC

Clearing, Grubbing and Disposing of Road Construction Slash, Oct. 1976—SDTDC

Roadside Slope Revegetation, June 1974—SDTDC

Flexible Downdrains, Jan. 1974—SDTDC

Tractor Attachments for Brush, Slash, and Root Removal, Jan. 1971—SDTDC

Results of Field Trials of the Tree Eater, Jan. 1970—SDTDC

Forestland Tree Planter, Sept. 1967—SDTDC

Pine Seed Drill, Sept. 1967—SDTDC

Project Reports

Facilities for Watering Livestock & Wildlife, January 1989—MTDC

Revegetating Slopes with Geotextiles and Geogrid Systems, Sept. 1985—MTDC

Premo Mark III Aerial Ignition System, May 1985—MTDC

Range Water Pumping Systems—State-of-the-Art-Review, Feb. 1985.—SDTDC

Field Equipment for Precommercial Thinning and Slash Treatment, Jan. 1984—SDTDC

Analysis of Spray Depostit Cards Sensitive to Nondyed Sprays, Feb. 1984—MTDC

Preventing Livestock Water from Freezing, Nov. 1983—SDTDC

Rangeland Fencing System State-of-the-Art Review, Oct. 1983—SDTDC

Evaluation of the Pettibone Slashmaster Model 900 for Site Preparation in the Lake States, Feb. 1983—SDTDC

Dryland Plug Planter, Dec. 1982—MTDC

Tree-Planting Machine—How Much Can You Afford to Pay for One?, June 1981—SDTDC

Sod Mover Bucket, Dec. 1980—MTDC

Tree/Shrub Planter for Roadside Revegetation, Oct. 1980—SDTDC

Observations on Operations of the Pettibone Hydro-Slasher PM 800, Feb. 1980—SDTDC

Basin Blade for Disturbed Land Revegetation, Nov. 1979—MTDC

Plastic Tubes for Protecting Seedlings from Browsing Wildlife, July 1979—MTDC

Mulching-Tilling Equipment for Soil Conditioning, Jan. 1979—MTDC

Evaluating Methods for Joining Polyethylene Pipe, Dec. 1978—MTDC

A Transplant System for Revegetating Surface Mined Lands, Nov. 1978—MTDC

Grapples for Forest Residues Concentration and Removal, Oct. 1978—SDTDC

Field Equipment for Precommercial Thinning and Slash Treatment, July 1978—SDTDC

Modified Hodder Gouger, Dec. 1977—MTDC

An Investigation of Equipment for Rejuvenating Browse, Aug. 1977—MTDC

Survey of High-Production Grass Seed Collectors, Jan. 19777—SDTDC

Remote Sensing for Big Game Counts, Dec. 2a976—MTDC

Evaluation of the Vermeer Model TS-44A Tree Spade for Transplanting Trees on Surface Mined Land, Feb. 1976—MTDC

Wildlife Habitat Management Needs, Oct. 2975—MTDC

Using Heat for Sagebrush Control, Feb. 1972—MTDC

Other Reports

MTDC Tree Harvester (Brochure), June 1989—MTDC

MTDC Chunker Manual, Sept. 1989—MTDC

Self-Propelled Flail Trencher, Nov. 1989—MTDC

An Introduction to GPS (Brochure), April 1989—MTDC

Global Positioning System Canopy Effects Study, Sept. 1989—MTDC

42 Annual Report—Vegetative Rehabilitation and Equipment Workshop, Nov. 1988—MTDC

41st Annual Report—Vegetative Rehabilitation and Equipment Workshop, Sept. 1987—MTDC

Fences, May 1988—MTDC

Evaluation of the Navcore 1 Positioning System, July 1988—MTDC

New Resource Tools and Equipment, July 1988—MTDC

Facilities for Handling, Sheltering, and Trailing Livestock, June 1987—MTDC

40th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Aug. 1986 —MTDC

39th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Dec. 1985—MTDC

Low-Cost Diagonal Fence Strainer (ASAE paper No. 84-1624), Dec. 1984—SDTDC

Improved and New Water Pumping Windmills (ASAE paper No. 84-1625), Dec. 1984—SDTDC

38th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Nov. 1984—MTDC

Reclaiming Disturbed Lands, Nov. 1984—MTDC

Manual of Revegetation Techniques, May 1984—MTDC

37th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Oct. 1983—MTDC

Development of a Containerized Shrub Injection Planter Attachment for a Backhoe—A Prospectus, Jan. 1983-SDTDC

Dryland Plug Planter—Operator's Manual, Jan. 1983—MTDC

History of the Vegetative Rehabilitation and Equipment Workshop (VREW) 1946-1982, Dec. 1982—MTDC

36th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Sept. 1982—MTDC

Punch Seeder for Arid and Semiarid Rangelands—A Prospectus, Sept. 1982—SDTDC

Development of a Disk-Chain Implement for Seedbed Preparation on Rangeland—A Prospectus, July 1982—SDTDC

Arid Land Seeder Development—A Prospectus, July 1982—SDTDC

Equipment for Containerized Tree Seedlings, July 1982—MTDC

Catalog for Hand Planting Tools, May 1982—MTDC

Sources of Seed and Planting Stock, Oct. 1982—MTDC

Sod Mover Operator's Manual, Feb. 1982—MTDC

Development of a Rangeland Interseeder for Rocky and Brushy Terrain (ASAE paper 80-1551), Dec. 1980—SDTDC

34th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Sept. 1980—MTDC

Modified Basin Blade—Operator's Manual, Mar. 1980—MTDC

Sodder Brochure, Mar. 1980—MTDC

Basin Blade Brochure, Mar. 1980—MTDC

Mulching-Tilling System Brochure, Mar. 1980—MTDC

Transplanting System Brochure, Mar. 1980—MTDC

Sprigger Brochure, Feb. 1980—MTDC

Dryland Plug Planter Brochure, Feb. 1980—MTDC

Revegetation Equipment Catalog, Feb. 1980—MTDC

Agricultural Engineer's Role in Rangeland Improvement and Rehabilitation Equipment (ASAE paper 790161), Dec. 1979—SDTDC

Observations on Operations of a Residue Shredder and a Brush Harvester, Sept. 1979—SDTDC

33rd Annual Report—Vegetative Rehabilitation and Equipment Workshop, July 1979—MTDC

Front-End Loader Tree Spade, Manual supplement, Feb. 1979 MTDC

354th Annual Report—Vegetative Rehabilitation and Equipment Workshop, Sept. 1981— TDC (Available from National Technical Information Service (NTIS) U.S. Department of Commerce, Springfield, VA 22161 for $10.50 in paper and $4 in milcorfiche.)

Concepts—Sod Mover, Aug. 1978—MTDC

Aerial Burning Equipment for Plant Control, Feb. 1977—MTDC

Handbook—Equipment for Reclaiming Strip Mined Land, Feb. 1977—MTDC

Rangeland Drill Operations Handbook, BLM Tech. Note 289, Sept. 1976—SDTDC

Evaluation of the "Vari-Dozer," Feb. 1974—SDTDC

Investigation of Selected Problems in Range Habitat Improvement, Feb. 1974—SDTDC

History—Range Seeding Equipment Committee 1946-1973, Jan. 1974—MTDC

Results: 1972 Range Improvement Survey (27th Annual Range Seeding Equipment Committee report), Feb. 1973—MTDC

Implement-Carrying Hitch for Forestry Use (ASAE paper) Dec. 1972—SDTDC

Efficiency and Economy of an Air Curtain Distructor Used for Slash Disposal in the Northwest (ASAE paper), Dec. 1972—SDTDC

Service & Parts Manual for the Contour Furrower Model RM 25, June 1970—SDTDC

Service & Parts Manual for the Brushland Plow, June 1968—SDTDC

Service & Parts Manual for the Rangeland Drill Models PD-10x6 and B-20x6, Aug. 1967—SDTDC

Other Publications of Interest to VREW

Equipment for Reforestation and Timber Stand Improvement, Oct. 1980—Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402; Request Stock No. 001-001-00563-1; $6.50

Private Water Systems Handbook, Midwest Plan Service, Iowa State University, Ames, IA 50011. $2.50

Water Systems Handbook (7th Edition), Water Systems Council, 221 North LaSalle St., Chicago, IL 60601. $6

Water Well Handbook, Keith E. Anderson, Missouri Water Well and Pump Contractors Association, Inc., P.O. Box 517, Belle, MO 65013. $10

Evaluation of Pumps and Motors for Photovoltaic Water Pumping Systems, David Waddington and A. Herievich, Solar Energy Research Insitute. Available from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161. $3 microfiche; $5.25 printed copy

Rangeland Drill, reprint from "Rangelands," vol. 4, no. 3, June 1981

Glossary of Surface Mining and Reclamation Terminology, Bituminous Coal Research, Inc., 350 Hochberg Rd., P.O. Box 278, Monroeville, PA 15146 (412) 327-1600. $2

Range Development and Improvements, 2nd edition, J.F. Vallentine, 1980 Brigham Young University Press, Provo, UT 84602. 545 p. $18.95

How to Build Fences with Max-ten 2-High Tensile Fence Wire, U.S. Steel Corp., P.O. Box 86 (C-1424), Pittsburgh,, PA 15230. $5 plus $1.50 postage and handling

How to Design An Independent Power System, Terrance D. Paul, Best Energy Systems for Tomorrow, Inc., P.O. Box 280, Necedah, WI 54646 (603 565-7200. $4.95.

From American Aossociation for Vocational Instructional Materials (AAVIM) Engineering Center, Athens, GA 30602:

> Planning for an Individual Water System,, No. 600, $6.95
>
> Planning Fences, No. 404, $4.25
>
> Building Fences, No. 405, $4.25

(For orders less than $10 add $1 postage and handling; for orders over $10 add 8 percent for postage and handling.)

Range and Pasture Seeding in the Southern Great Plains, Proceedings of a symposim on the newest grasses, seeding techniques, and seed harvesting/processing equipment, Oct. 29, 1983, Vernon, TX 76384, Texas A&M Univ., Agricultural Research and Extension Center, Vernon, TX, 115 pages, $5. Order Seeding Proceedings Attn: Harold Wiedemann, Texas Agricultural Experiment Station, P.O. Box 1658, Vernon, TX 76384

Windmills and Pumps of the Southwest, Dick Hays and Bill Allen, Eakin Press, P.O. Box 23066, Austin, TX 78735, 110 p $7.95

Electric Fencing for Rangelands, Special Series 27, Colorado State Univ., Agricultural Experiment Station, Fort Collins, CO. Order from Bulletin Room, Colorado State Univ., Fort Collins, CO 80523 , (303) 491-6198, $3.25 post paid

Small-Scale Solar-Powered Pumping System: The Technology, Its Economics and Advancement; main report by Sir William Halcrow and Partners in association with Intermediate Technology Power, Ltd., for the World Bank under project UNDP Project GLO/80/003, June 1983

Farm Show, published bimonthly by Farm Show Publishing, P.O. Box 704, Lakeville, MN 55044, (612) 469-5572, $9.95/ year

Drawings at SDTDC

Pipe Harrow, RM1-01 and 02

Brushland Plow, RM2-01 to 22

Oregon Press Seeder Assembly (not complete), RM 19-01 to 07

Plastic Pipe Layer Assembly, RM21-01-03

Reel for Laying Plastic Pipe, RM 14-01

Contour Furrowers, RM25-01 to 14

Rangeland Drill Deep Furrowing Arms, RM 26-46 to 61

Steep-Slope Seeder, RM 33-01-18

Demonstration Interseeder for Rocky and Brushy Areas, RM 35-01-09

Drawings at MTDC

B.C. Drag Chain Scarifier, No. 790

Disk Chain Implement, No. 757

Optional Dryland Sodder Bucket, No. 682

Sprig Spreader, No. 652

Sprig Harvester, No. 651

Dryland Sodder, No. 631

Tubling Planter, No. 628

Basin Blade, No. 619

Horse Trap Trigger, No. 618

Mulch Spreader, No. 611

Tree Transport Container, No. 604

Tree Transplant Trailer, No. 6702

Modified Hodder Gouger, No. 583

Dixie Sager and Modified Ely Chain, No. 568

Incendiary Grenade Dispenser, No. 522

Attendance at Annual Meetings

Meeting			Participants				
Date	Place	Presiding Chairman	Federal Gov't	State Gov't	Private	Foreign	Total
Dec 1946	Portland[1]	Joseph F. Pechanec	6	0	0	0	6
Dec 1947	Ogden[1]	" "	9	0	0	0	9
Jan 1949	Denver	" "	15	0	0	0	15
Dec 1949	Ogden[1]	" "	22	0	0	0	22
Jan 1951	Billings	" "	34	5	0	0	39
Jan 1952	Boise	A.C. Hull	45	9	0	0	54
Jan 1953	Albuquerque	"	75	15	9	1	100
Jan 1954	Omaha	"	63	8	3	5	79
Jan 1955	San Jose	W.W. Dresskell	62	10	4	1	77
Jan 1956	Denver	William D. Hurst	86	12	1	2	101
Jan 1957	Great Falls	" "	95	10	4	0	109
Jan 1958	Phoenix	Frank C. Curtis	87	9	3	0	99
Jan 1959	Tulsa	" "	84	5	2	0	91
Jan 1960	Portland	" "	98	10	3	3	114
Jan 1961	Salt Lake City	" "	123	11	14	2	150
Jan 1962	Corpus Christi	Frank Smith	58	5	7	1	71
Jan 1963	Rapid City	" "	52	6	1	0	59
Jan 1964	Wichita	John Forsman	61	10	5	0	76
Jan 1965	Las Vegas	" "	77	8	6	0	91
Feb 1966	New Orleans	" "	47	8	5	1	61
Feb 1967	Seattle	A.B. Evanko	58	10	4	0	72
Feb 1968	Albuquerque	" "	84	16	13	1	114
Feb 1969	Great Falls[1]	" "	46	3	13	0	61
Feb 1970	Denver	" "	81	8	11	0	100
Feb 1971	Reno	" "	74	6	15	2	97
Feb 1972	Wash., D.C.	" "	48	3	6	0	57
Feb 1973	Boise	" "	60	7	7	4	78
Feb 1974	Tucson	Bill F. Currier	61	12	10	14	97
Feb 1975	El Paso[1]	Stan Tixier	49	9	11	1	70
Feb 1976	Omaha	" "	50	17	12	0	79
Feb 1977	Portland	Vern L. Thompson	63	26	31	10	130
Feb 1978	San Antonio	" "	68	26	35	6	135
Feb 1979	Casper	Ted Russell	74	35	72	12	193
Feb 1980	San Diego	" "	97	44	88	21	250
Feb 1981	Tulsa	" "	56	35	111	16	218
Feb 1982	Denver[1]	" "	60	18	68	5	151
Feb 1983	Albuquerque	" "	119	82	96	9	306
Feb 1984	Rapid City	Randall R. Hall	95	22	49	7	173
Feb 1985	Salt Lake City	" "	110	46	85	13	254
Feb 1986	Orlando	Gerald Henke	41	31	29	13	114
Feb 1987	Boise	" "	94	35	34	5	168
Feb 1988	Corpus Christi	" "	42	14	23	8	87
Feb. 1988	Billings	Gerald Henke	65	19	23	2	109

[1] Meeting not in conjuction with Society for Range Management meeting.

1989 Workgroups

Persons interested in participating in the activities of a workgroup are encouraged to write or call the workgroup chairman about their interest.

Information and Publications

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